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(71)Applicant : FUJITSU LTD

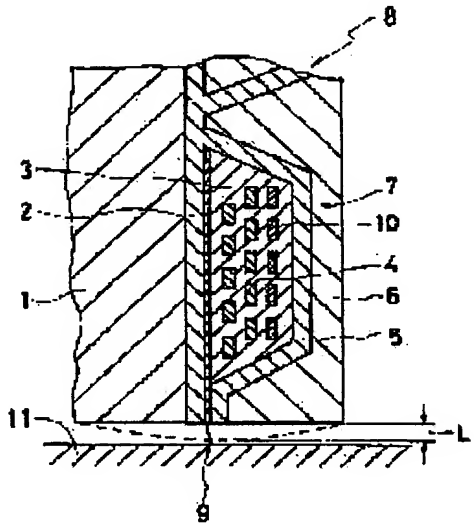
(72)Inventor : YAMAMOTO NAOYUKI
TAKAHASHI MINORU
SHINOHARA MASAKI

(54) MAGNETIC HEAD AND MAGNETIC DISK DEVICE

(57)Abstract:

PURPOSE: To decrease the spacing between the front end of magnetic poles and a magnetic disk surface by projecting the front ends of the magnetic poles of the magnetic head at need.

CONSTITUTION: The magnetic head 8 is formed by having a thin-film magnetic head element 7 successively formed with the lower magnetic pole 2, a thin-film coil 4 formed by being insulated with an insulator layer 3, the upper magnetic pole 5, and a protective layer 6 on a substrate 1. A thin-film insulator 10 which is constituted to thermally expand and project the front end 9 of the magnetic pole when energized to generate heat at need is formed within the insulator layer 3, by which the magnetic head having the thin-film magnetic head element is obtd.



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CLAIMS

[Claim(s)]
[Claim 1] In the thin film coil (4) which was insulated with the lower magnetic pole (2) through the insulator layer (3), and was formed on the substrate (1), and an up magnetic pole (5) and the magnetic head (8) which has the thin film magnetic-head component (7) by which sequential formation of the protective layer (6) was carried out The magnetic head which energizes if needed and has the thin film magnetic-head component characterized by forming in the interior of said insulator layer (3) the thin film resistor (10) carries out thermal expansion of the magnetic pole point (9), and it was made to make it project by making it generate heat.
[Claim 2] The thin film coil which was insulated with the lower magnetic pole (2) through the insulator layer (3), and was formed on the substrate (1) (4), In the magnetic disk drive using the magnetic head (8) which has an up magnetic pole (5) and the thin film magnetic-head component (7) by which sequential formation of the protective layer (6) was carried out When said magnetic head (8) performs read/write to a magnetic disk The thin film resistor (10) energized, and carries out thermal expansion of the magnetic pole point (9), and it was made to make it project by making it generate heat is formed in the interior of the insulator layer (3) of said thin film magnetic-head component (7). The magnetic disk drive characterized by constituting so that the gap of this and a magnetic-disk (11) side may be made small by the protrusion of a magnetic pole point (9).
[Claim 3] The magnetic disk drive characterized by establishing the control means which an acoustic emission sensor (13) is attached in a carriage arm (12), and an acoustic emission sensor (13) detects contact vibration with said thin film magnetic-head component (7) and magnetic-disk (11) side in a magnetic disk drive according to claim 2, and controls the energization current to said thin film resistor (10).
[Claim 4] The magnetic disk drive characterized by establishing the control means which controls the energization current to said thin film resistor (10) according to the level of the lead output of a magnetic disk (11) of said thin film magnetic-head component (7) in a magnetic disk drive according to claim 2.
[Claim 5] The thin film coil which was insulated with the lower magnetic pole (2) through the insulator layer (3), and was formed on the substrate (1) (4), In the magnetic disk drive using the magnetic head (8) which has an up magnetic pole (5) and the thin film magnetic-head component (7) by which sequential formation of the protective layer (6) was carried out The thin film resistor (10) carries out thermal expansion of the magnetic pole point (9), and it was made to make it project by making it energize and generate heat before rotation of a magnetic disk (11) is formed in the interior of the insulator layer (3) of said thin film magnetic-head component (7). The magnetic disk drive characterized for the magnetic head (8) and a magnetic disk (11) by point contact or constituting so that line contact may be carried out.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] Thermal expansion of the magnetic pole point is carried out, and it is made for this invention to make it project by energizing to the thin film resistor with which the interior of a thin film magnetic-head component was equipped especially if needed, and making it generate heat about the magnetic disk drive which used the magnetic head which has a thin film magnetic-head component, and this magnetic head.
[0002]
[Description of the Prior Art] In recent years, the magnetic head which has a thin film magnetic-head component as the smaller and precise magnetic head is adopted by the demand of the miniaturization of a magnetic disk drive, and large-capacity-izing. Drawing 6 is the partial expanded sectional view of the conventional thin film magnetic-head component, sequential formation of the thin film coil 4 which was insulated and was formed through the lower magnetic pole 2 and the insulator layer 3 of the organic substance on the substrate 1 by means, such as sputtering, the up magnetic pole 5, and the protective layer 6 is carried out, and the smaller and precise magnetic head is manufactured.
[0003] In order to improve the read/write property of such the magnetic head, efforts to make smaller the flying height from the magnetic-disk side of the magnetic head are paid. On the other hand, in order to prevent that the magnetic head sticks to a magnetic disk in a magnetic-disk side at the time of the halt, the so-called texture processing which forms a detailed slot in a magnetic-disk side along with a circumferencial direction is performed.
[0004] Moreover, in order to prevent that the magnetic head sticks to a magnetic-disk side at the time of a halt of a magnetic disk, from the slider side which contacts the front face at the time of a rotation halt of a magnetic disk, prepare a piezoelectric device in the slider which forms the magnetic head so that it may project at the time of electrical-potential-difference impression, and a piezoelectric device is made to project to it from a slider side by electrical-potential-difference impression, and some which lost adsorption to the magnetic-disk side of a slider side are in it.
[0005]
[Problem(s) to be Solved by the Invention] However, if the flying height from the magnetic-disk side of the magnetic head is made smaller in order to improve the read/write property of the magnetic head, the probability of contact to the magnetic head and a magnetic-disk side will be made high, and the so-called danger of a head crash will also increase.
[0006] Moreover, the method of attaching a piezoelectric device in the slider which forms the magnetic head could not unify a piezoelectric device in the production process of a thin film magnetic-head component, but had to form the attachment slot which attaches a piezoelectric device in a slider, and had to use the complicated trouble and the precise processing technique of connecting the lead wire for electrical-potential-difference impression for the piezoelectric device attached in this attachment slot. Moreover, in order to have operated this piezoelectric device, the high electrical potential difference of 80-150V needed to be impressed, and the power source of a high electrical potential difference was required apart from the actuation power source of a magnetic disk drive.
[0007] This invention aims at offering the magnetic head which has the thin film magnetic-head component which this can be made to approach a magnetic-disk side, however the risk of a head crash does not have, either, and offering the magnetic disk drive which used this magnetic head by making the magnetic pole point of a thin film magnetic-head component project if needed, without attaching the above piezoelectric devices in the slider of the magnetic head.
[0008] Moreover, or other purposes of this invention have not performed the so-called texture processing, they are offering the magnetic disk drive to which the magnetic head's does not stick also to a magnetic disk with little texture processing.
[0009]
[Means for Solving the Problem] In order that this invention may solve said technical problem, as shown in drawing 1

and drawing 3 - drawing 5 In the magnetic head 8 which has the thin film magnetic-head component 7 by which sequential formation of the thin film coil 4 which was insulated with the lower magnetic pole 2 through the insulator layer 3, and was formed on the substrate 1, the up magnetic pole 5, and the protective layer 6 was carried out It energizes if needed and considers as the magnetic head 8 which has the thin film magnetic-head component 7 in which the thin film resistor 10 carries out thermal expansion of the magnetic pole point 9, and it was made to make it project was formed to the interior of said insulator layer 3 by making it generate heat.

[0010] Moreover, other invention constitutes the magnetic disk drive which controls the energization to said thin film resistor 10, controls suitably the amount of protrusions of the magnetic pole point 9, and controlled the magnetic head 6 and page [of a magnetic disk / 11th] gap in the magnetic disk drive which used the magnetic head 8 which has said thin film magnetic-head component 7.

[0011]

[Function] The thin film coil 4 which this invention was insulated with the lower magnetic pole 2 through the insulator layer 3 on the substrate 1 as mentioned above, and was formed, Since sequential formation of the up magnetic pole 5 and the protective layer 6 is carried out and the thin film resistor 10 is formed especially in the interior of the insulator layer 3 If it energizes to this thin film resistor 10 and it is made to generate heat, it projects, as the magnetic pole point 9 shows by the dotted line by drawing 1 according to the difference in the coefficient of thermal expansion between both the magnetic poles 2 and 5 and the insulator layer 3, and a substrate 1 and a protective layer 6.

[0012] Since the amount of protrusions of this magnetic pole point 9 is proportional to the calorific value of a thin film resistor 10, if the current which flows to this thin film resistor 10 is controlled, the amount of protrusions of the magnetic pole point 9 is controllable. Therefore, in a magnetic disk drive, a gap with the 11th page of a magnetic disk and a magnetic pole point is controllable by controlling the amount of protrusions of said magnetic pole point 9.

[0013] moreover, the condition which put the magnetic head 8 on the 11th page of a magnetic disk when energize to said thin film resistor 10, it is made to generate heat before rotation of a magnetic disk and the magnetic pole point 9 was made to project -- it is -- the projected magnetic pole point 9 -- setting -- the 11th page of a magnetic disk -- point contact -- or since line contact is carried out, adsorption to the magnetic-disk side of the magnetic head is prevented.

[0014]

[Example] Hereafter, the example of this invention is explained with a drawing. Drawing 1 is the partial expanded sectional view of the thin film magnetic-head component which forms the magnetic head of this invention, and 1 is the substrate which consists of alumina titanium carbon (aluminum2O3-TiC) etc. The protective layer 6 of an alumina carries out a sequential membrane formation laminating to the thin film resistor 10 which consists of the thin film coil 4, a tungsten, etc. which were formed through the lower magnetic pole 2 and the insulator layer 3 of the organic substance by the sputtering method etc. on this substrate 1, and the up magnetic pole 5 further, and it is formed.

[0015] If it energizes to the thin film resistor 10 which it has in the thin film magnetic-head component 7 formed as mentioned above and it is made to generate heat, since the coefficient of thermal expansion of the insulator layer 3 of the organic substance, the lower magnetic pole 2, and the up magnetic pole 5 is larger than the coefficient of thermal expansion of a substrate 1 and a protective layer 6, it projects, as the magnetic pole point 9 shows by the dotted line by drawing 1 .

[0016] The amount L of protrusions of this magnetic pole point 9 is proportional to the exoergic temperature of said thin film resistor 10, as shown in drawing 2 . For example, the amount of protrusions at the time of 100 degrees C is 0.02 micrometers, and it is 0.04 micrometers at the time of 200 degrees C. If 0.1 micrometers of flying heights of the magnetic head are assumed, as for this value, it is possible to be able to decrease the gap of the magnetic head and a magnetic disk 40% conventionally, and to make track recording density increase. Moreover, if the current passed to the calorific value 10 of a thin film resistor 10, i.e., a thin film resistor, is controlled, the amount of protrusions of the magnetic pole point 9 is controllable.

[0017] Then, by applying the magnetic head of said invention of this to a magnetic disk drive, and controlling the current passed to a thin film resistor 10 so that it may state below explains the example which controlled the gap of the magnetic head and a magnetic-disk side.

[0018] Drawing 3 is the partial perspective view of the magnetic disk drive of this invention, and drawing 4 is that block circuit diagram. In this drawing, 8 is the magnetic head which has the thin film magnetic-head component 7 of said invention of this, and is attached in point 14a of the spring arm 14. Back end section 14b of this spring arm 14 is attached in the point of the carriage arm 12. 13 is an acoustic emission sensor attached in the carriage arm 12, and this detects contact vibration generated when the magnetic head 8 contacts the field of a magnetic disk 11, and generates a signal.

[0019] The output signal of the acoustic emission sensor 13 is amplified with amplifier 15, and is inputted into a

controller 16 in the first half. On the other hand, the lead signal from the magnetic disk 11 of the magnetic head 8 is amplified with amplifier 17, and is inputted into a controller 16. The output of a controller 16 controls the energization controller 18, and controls the current which flows to the thin film resistor 10 inside said thin film magnetic-head component 7 which forms the magnetic head 8. Therefore, if it energizes to said thin film resistor 10 and the magnetic pole point 9 is made to project at the time of the read/write of the magnetic head, the gap L with the 11th page of a magnetic disk and the magnetic head 8 can be made small, and a read/write property can be improved.

[0020] Next, the flow chart which shows actuation of said controller 16 to drawing 5 explains. First, as energize to said thin film resistor 10 inside the thin film magnetic-head component 7 which forms the magnetic head 8, make this generate heat, the magnetic pole point 9 is made to project and this and the 11th page of a magnetic disk become point contact or line contact, it is made for the magnetic head 8 not to stick to the 11th page of a magnetic disk in a step (1).

[0021] Next, in a step (2), if a magnetic disk 11 begins rotation, in a step (3), the detection output of said acoustic emission sensor (AE) 13 is judged, when it is larger than a reference value, in (YES) and a step (4), the energization to the thin film resistor 10 of the thin film magnetic-head component 7 will be stopped, generation of heat will be suppressed, and the protrusion of the magnetic pole point 9 will be controlled.

[0022] Moreover, the lead output from the magnetic disk 11 of the magnetic head 8 is judged, in a step (5), the detection output of said acoustic emission sensor (AE) 13 is judged, when it is smaller than a reference value, (NO) and said energization are continued, when it is larger than a reference value, the energization to the thin film resistor 10 of (YES) and the thin film magnetic-head component 7 is stopped, generation of heat is suppressed, and the protrusion of the magnetic pole point 9 is controlled.

[0023] Moreover, said lead output is judged, when it is smaller than a reference value, in (NO) and a step (6), the current to the thin film resistor 10 of the thin film magnetic-head component 7 is enlarged, generation of heat is enlarged, and the amount of protrusions of the magnetic pole point 9 is enlarged.

[0024] Repeating the above actuation, by controlling the energization to the thin film resistor 10 in the thin film magnetic-head component 7, the amount of protrusions of the magnetic pole point 9 can be controlled, and it can control so that the magnetic head 8 and page [of a magnetic disk / 11th] gap becomes the optimal.

[0025]

[Effect of the Invention] In the magnetic head in which the thin film coil with which it insulated with the lower magnetic pole through the insulator layer, and this invention was formed on the substrate, an up magnetic pole, and a protective layer have the thin film magnetic-head component by which sequential formation was carried out as explained above Energize if needed, and since it considered as the magnetic head which has the thin film magnetic-head component in which the thin film resistor carries out thermal expansion of the magnetic pole point, and it was made to make it project by making it generate heat was formed to the interior of said insulator layer By the production process being almost the same as the former, and energizing to said thin film resistor before rotation of a magnetic disk, and making this heat Thermal expansion of the magnetic pole point is carried out, it can be made to be able to project, the slider side of the magnetic head can be made to be able to estrange from a magnetic-disk side, and it can prevent that a slider side sticks to a magnetic-disk side.

[0026] Moreover, since the gap of a magnetic pole point and a magnetic-disk side can be made small by energizing to said thin film resistor, making it generate heat at the time of the read/write of the magnetic head, and making a magnetic pole point project, track recording density can be made to increase.

[0027] Furthermore, since the gap of a magnetic pole point and a magnetic-disk side can always be kept the optimal by controlling the current passed to said thin film resistor, and controlling the amount of protrusions of a magnetic pole point at the time of the read/write of the magnetic head, risk, such as a head crash, also disappears and, moreover, it is the thing which has always high dependability and which can do read/write of high density.

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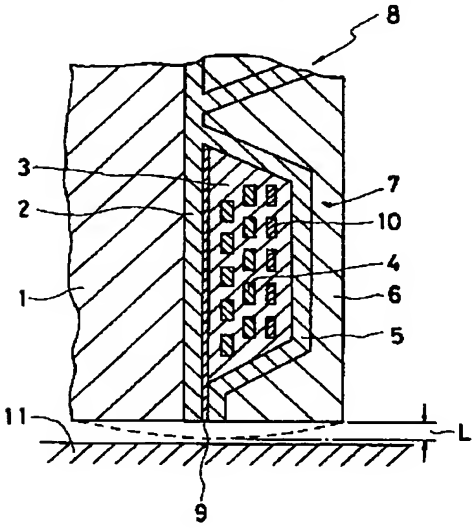
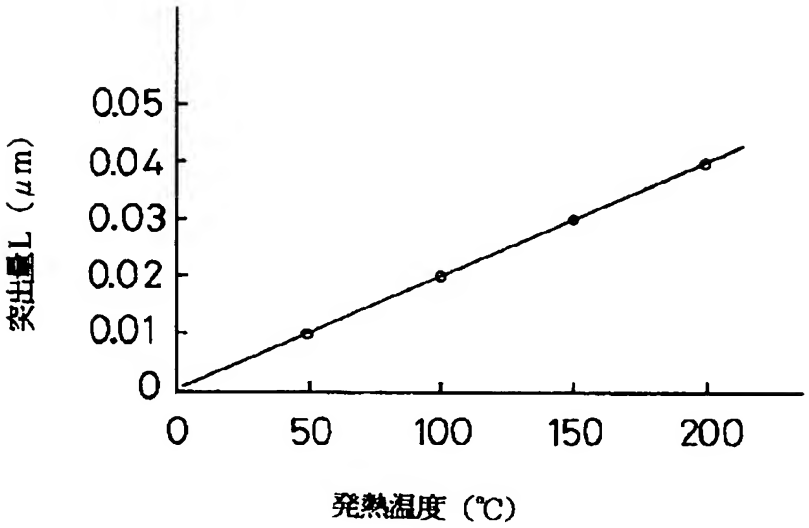
DRAWINGS

[Drawing 1]
この発明の磁気ヘッドを形成する薄膜磁気ヘッド素子部の拡大断面図

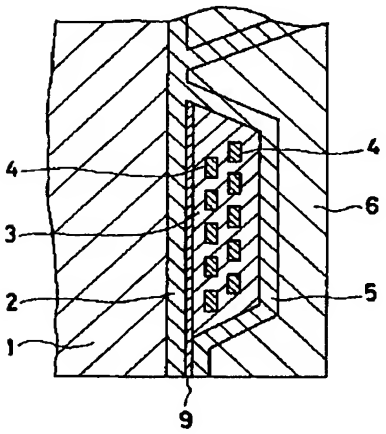


[Drawing 2]

この薄膜磁気ヘッド素子の薄膜抵抗体の発熱温度と磁極先端部の突出量との関係を示すグラフ

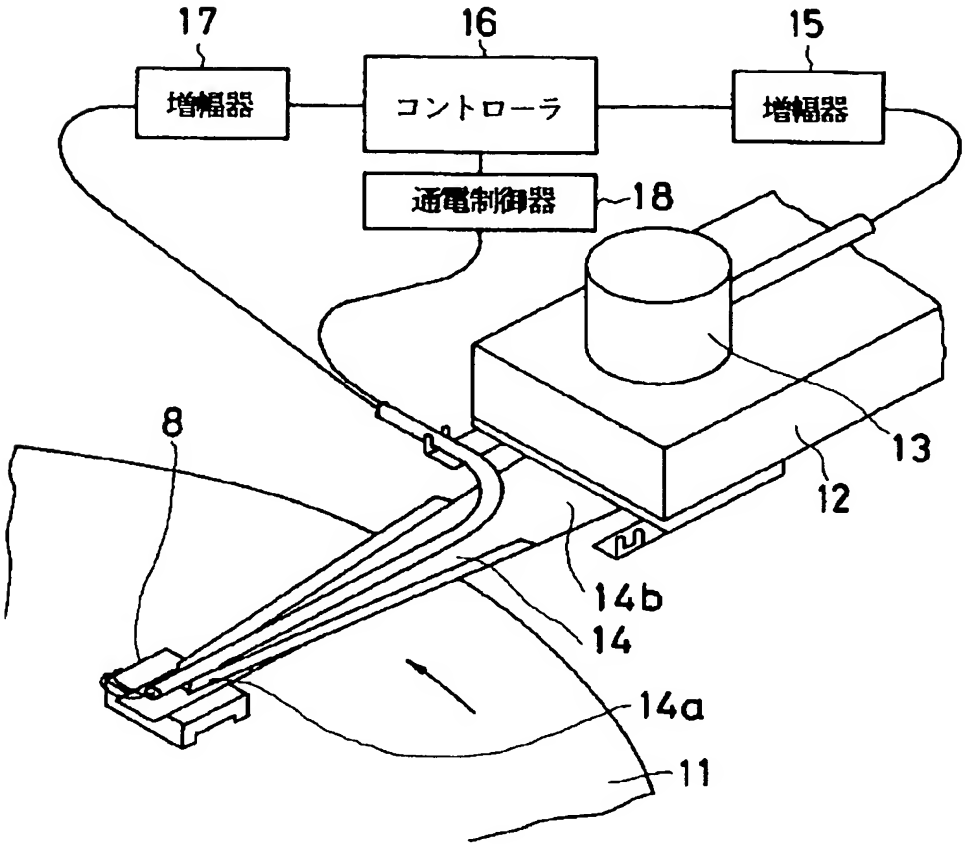


[Drawing 6]
従来の薄膜磁気ヘッド素子の拡大断面図



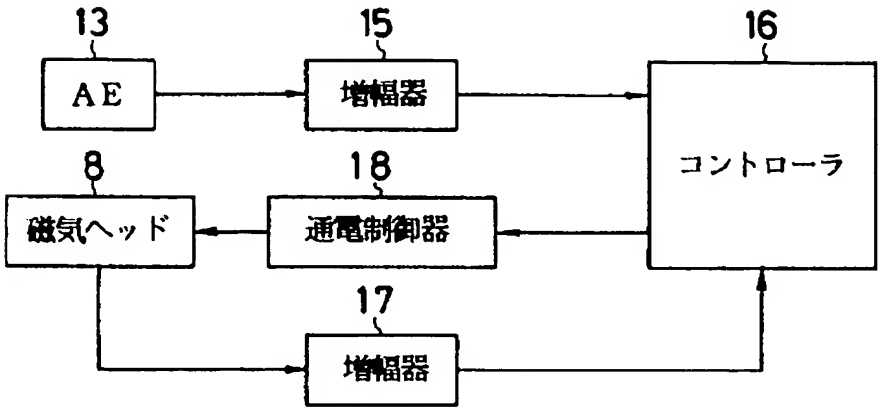
[Drawing 3]

この発明の磁気ディスク装置の主要部分を示す斜視図



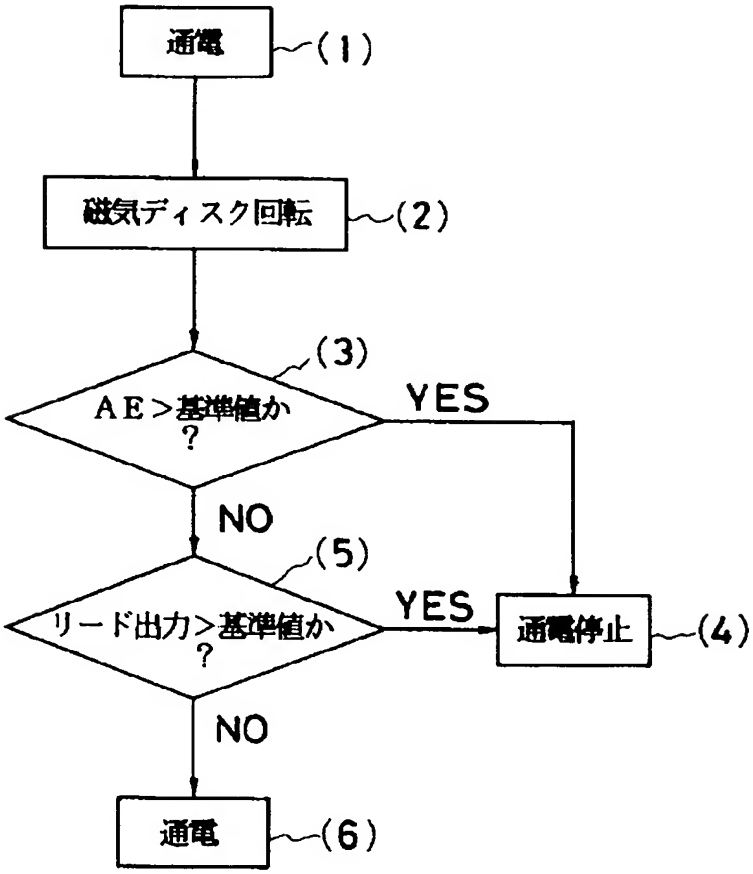
[Drawing 4]

この発明に係る制御回路のブロック図



[Drawing 5]

この発明に係るコントローラの動作を示すフローチャート



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